Green Horse Project:
Soils Effects Analysis Supplement

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Methodology

This section includes a description of the methods and data used in this analysis.

Those activities that are expected to have direct, indirect, and/or cumulative effects on the soil resource are: tractor harvest (approx. 480 acres), skyline harvest (approx. 1,208 acres), temporary road/swing trail construction (approx. 2 miles), and prescribed burning (approx. 572 acres). Associated skid trails, skyline corridors, and site preparation activities (broadcast and/or jackpot burning, hand and/or mechanical piling, mastication of activity-generated fuels) are included in the calculations for the harvest activities. Though permanent roads impact both soil productivity and soil stability, they are not considered in the soils analysis, as the evaluation of effects of permanent roads is most effectively done at the watershed scale (U.S. Department of Agriculture, Forest Service, Northern Region 2014). Naturally occurring events such as wildfire and landslides are also likely to impact the soil resource, but are not considered in the analysis of cumulative detrimental soil disturbance (Page-Dumroese and others 2009a; U.S. Department of Agriculture, Forest Service 2011).

LiDAR imagery, aerial imagery, past harvest data, GIS-generated reports and maps, and spatial analysis were used to estimate the current state of Detrimental Soil Disturbance (DSD) resulting from past land management activities and inherent soil characteristics. Where appropriate (i.e. similar soils and proposed harvest methods), activity units were grouped into landscape units for analysis. Potential increases in DSD expected from the proposed management activities were then calculated using assumptions based on local research and monitoring results (Archer 2008; Reeves and others 2011). The assumptions used in the calculations can be found in the "Calculations & Assumptions" tab of the Green Horse DSD Calculations Excel Workbook.

Activity units with an estimated DSD exceeding the Forest Plan standard of 20% were field-surveyed using the Forest Service Disturbance Monitoring Protocol (Page-Dumroese and others 2009a) in August 2020 to gain a more complete understanding of the distribution and causes of DSD in these units and to develop appropriate mitigations. The data from these surveys can be found in the Green Horse Soil Field DSD Survey 123 Excel Workbook. For more information on the statistical background underlying the Forest Service Disturbance Monitoring Protocol and the limitations of using DSD surveys as an indicator of soil productivity, see the suite of documents developed by the Rocky Mountain Research Station (Napper and others 2009; Page-Dumroese and others 2012; Page-Dumroese and others 2009a, 2009b; Page-Dumroese and others 2010).

Potential landslide-prone areas and their prevalence within the project area were evaluated via spatial analysis using a combination of soil and slope characteristics. Areas with high potential surface erosion risk were evaluated through an erosion hazard assessment using the mapped soil properties of the various soil types coinciding within the proposed activity units.

The spatial boundary for the effects analysis is the approx. 9550-acre Green Horse Project Area. The effects of Forest Management activities on soils is site-specific (Page-Dumroese and others 2009a), and thus all direct, indirect, and cumulative effects will occur within project activity units and associated

temporary roads and landings. Effects to the soil resource can last for decades (Froehlich and McNabb 1983; Powers and others 2005); as such, the temporal boundaries extend to all ground-disturbing activities that occurred within the last 40 years and to all reasonably foreseeable activities that may occur within the next 40 years.

Resource Indicators and Measures

Two resource elements, soil productivity and soil stability, have been developed as gauges of the soil's quality and ability to function. The status of these resource elements is evaluated by analyzing specific resource indicators, as summarized in Table 1 below. These resource indicators are used in the soils analysis to efficiently assess the condition of the soil in its present state, the effects of proposed actions, compliance with regulatory standards, and the need for site-specific mitigation measures.

Soil Productivity

Soil productivity is defined by the Forest Service as "the inherent capacity of the soil resource to support appropriate site-specific biological resource management objectives, which includes the growth of specified plants, plant communities, or a sequence of plant communities to support multiple land uses" (U.S. Department of Agriculture, Forest Service 2010). Detrimental Soil Disturbance (DSD) is a measure of visually-assessed soil attributes that give a snapshot of the soil's current condition and from which assumptions about soil productivity may be made (U.S. Department of Agriculture, Forest Service, Northern Region 2014). The soil quality indicators visually assessed while conducting DSD surveys are:

- Forest floor attributes (ground cover, litter depth, amount of coarse woody debris)
- Surface soil attributes (topsoil displacement, erosion, ruts, puddled conditions, burn severity)
- Subsurface soil attributes (compaction, platy/massive structure)

Changes in these attributes indicate direct effects (occurring at the same time and place as the management action) to the soil resource resulting from management activities. Indirect effects (temporally or spatially removed from the management action) to the soil resource are any adverse impacts caused by management activities to one or more of the soil's six main functions: soil biology, soil hydrology, nutrient cycling, carbon storage, stability and support, or filtering and buffering (U.S. Department of Agriculture, Forest Service 2010). Adverse impacts to one or more of these soil functions can result in a decline in soil productivity, depending on the soil type impacted, the climate, and the timing and extent of the impact(s).

Regional soil quality standards have been developed to set a guideline for maintaining soil quality, and thereby for maintaining soil productivity. For Region 1, the guideline is defined as follows:

> Design new activities that do not create detrimental soil conditions on more than 15 percent of an activity area. In areas where less than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 15 percent. In areas where more than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration should not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality. (U.S. Department of Agriculture, Forest Service, Northern Region 2014)

The rationale for the 15% limit of change in soil bulk density was largely based on the collective judgment of soil researchers, academics, and field practitioners, and the accepted inability to detect changes in productivity less than 15% using current monitoring methods (Powers 1990). Powers (1990) states that the soil quality guidelines are set to detect a decline in potential

productivity of at least 15%. This statement does not mean that the Forest Service tolerates productivity declines at this level, but that it recognizes problems with detection limits.

The extent of detrimental disturbance caused by forest management activities is dependent on the inherent properties of the soil, as well as the activity, equipment used, method and season of operation, and silvicultural prescription (Page-Dumroese and others 2009b).

Soil Stability

Soil stability is indicated by the extent of erosion (rills, gullies, pedestals, soil deposition) and mass wasting (e.g. landslides). Erosion and mass wasting are natural geomorphic processes and are fundamental factors in shaping the landscape on the Nez Perce-Clearwater National Forests (USDA Natural Resources Conservation Service 2009), but they can be accelerated by human disturbances (Megahan 1990). Forest management activities, especially timber harvest and construction of temporary roads, can impact soil stability by removing ground cover and displacing surface soils.

Direct effects to soil stability include the loss of topsoil and the triggering of mass wasting events directly attributable to project activities. Indirect effects to soil stability occur when surface soils are moved downslope by erosion, causing loss of soil function due to surface soils' higher capacity to hold moisture and nutrients (and therefore support stabilizing plant and root growth) than subsurface soils. Indirect effects to soil stability can also occur when a management activity involving removal of stabilizing vegetation leads to conditions that result in erosion and/or mass wasting events that are temporally removed from the management activity.

The Project Area has been mapped by the Natural Resources Conservation Survey into soil map units, which are collections of areas containing similar soils (USDA Natural Resources Conservation Service 2009). Soil stability can be predicted by assessing certain characteristics of the soils present in each map unit, as well as by looking for evidence of surface erosion and mass wasting in the field. Potential landslide-prone are comprised of slopes 60% and greater and/or areas that fall on steep landslide deposits (soil map units 50EUU and 50CUU). The surface erosion hazard rating considers volcanic ash topsoil characteristics, slope gradient, depth to restricting layers, and slope shape. Field indicators of areas prone to mass wasting include: steep (over 60%) concave slopes; hydrophytic vegetation (i.e. sedges, moist site ferns); slumps, draws, and basins; past landslide locations; and obvious soil movement areas (typically indicated by curved and/or buttressed tree boles, soil creep, tension cracks, etc.).

Table 1. Resource Indicators and Measures for Assessing Project Effects

Resource Element	Resource Indicator	Measure	Source
Soil Productivity	Detrimental Soil Disturbance (DSD)	Percent DSD per Activity Area	Nez Perce National Forest Plan
Soil Stability	Soil Erosion Hazard Potential	Acres of Proposed Harvest on Landslide-Prone Terrain	Nez Perce National Forest Plan
		Miles of Proposed Temporary Road on Landslide-Prone Terrain	Nez Perce National Forest Plan
		Acres of Proposed Harvest on Soils Rated High Risk for Surface Erosion	Nez Perce National Forest Plan
		Miles of Proposed Temporary Road on Soils Rated High Risk for Surface Erosion	Nez Perce National Forest Plan

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